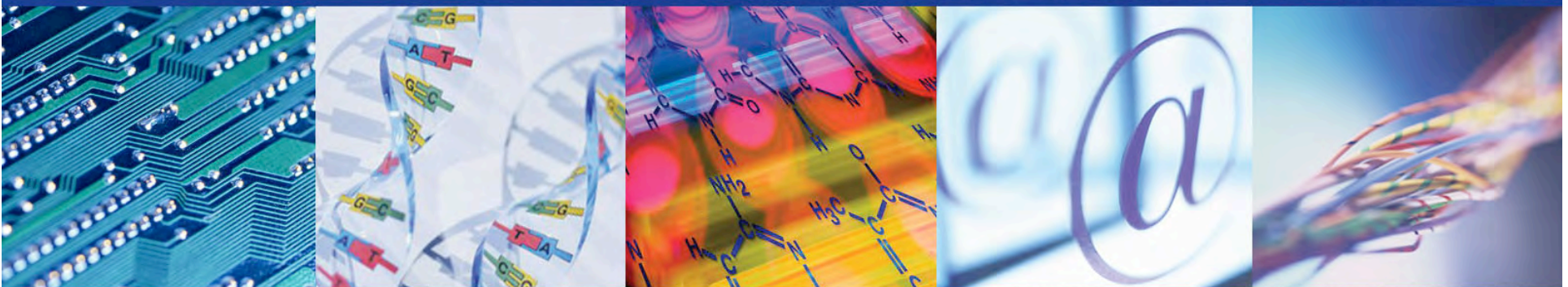




*venture investing*

EARLY | ACTIVE | COMMITTED



# Building Fuel Cell Companies – Challenges & Opportunities

Marianne Wu

May 31, 2006

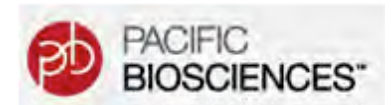
- **About MDV**
- **Cleantech Venture Investment Trends**
- **Fuel Cell Market Overview**
  - Opportunities
  - Challenges



- Founded 1983
- Eight funds raised
- \$1.4 B under management
- Early Stage focus
- Significant Tech transfer expertise and experience



- Energy and Materials
- Internet Services
- Life Sciences
- Semiconductors
- Software and Systems



- Breakthroughs in engineering and science going after ***huge new markets***
- Opportunity for disruptive technology to ***displace incumbents with significant value proposition***
- ***Accessible channel*** for startups
- Diversified customer set
- High margin businesses

***Market Solutions not Technology Platforms***

## **3 Great Trends define the present day:**

- Demographic, as we multiply from 6B to 9B people
- Economic, as the 2<sup>nd</sup> Wave of Global Industrialization rages
- Environmental, as we operate within the Earth's resources

## **Resulting in:**

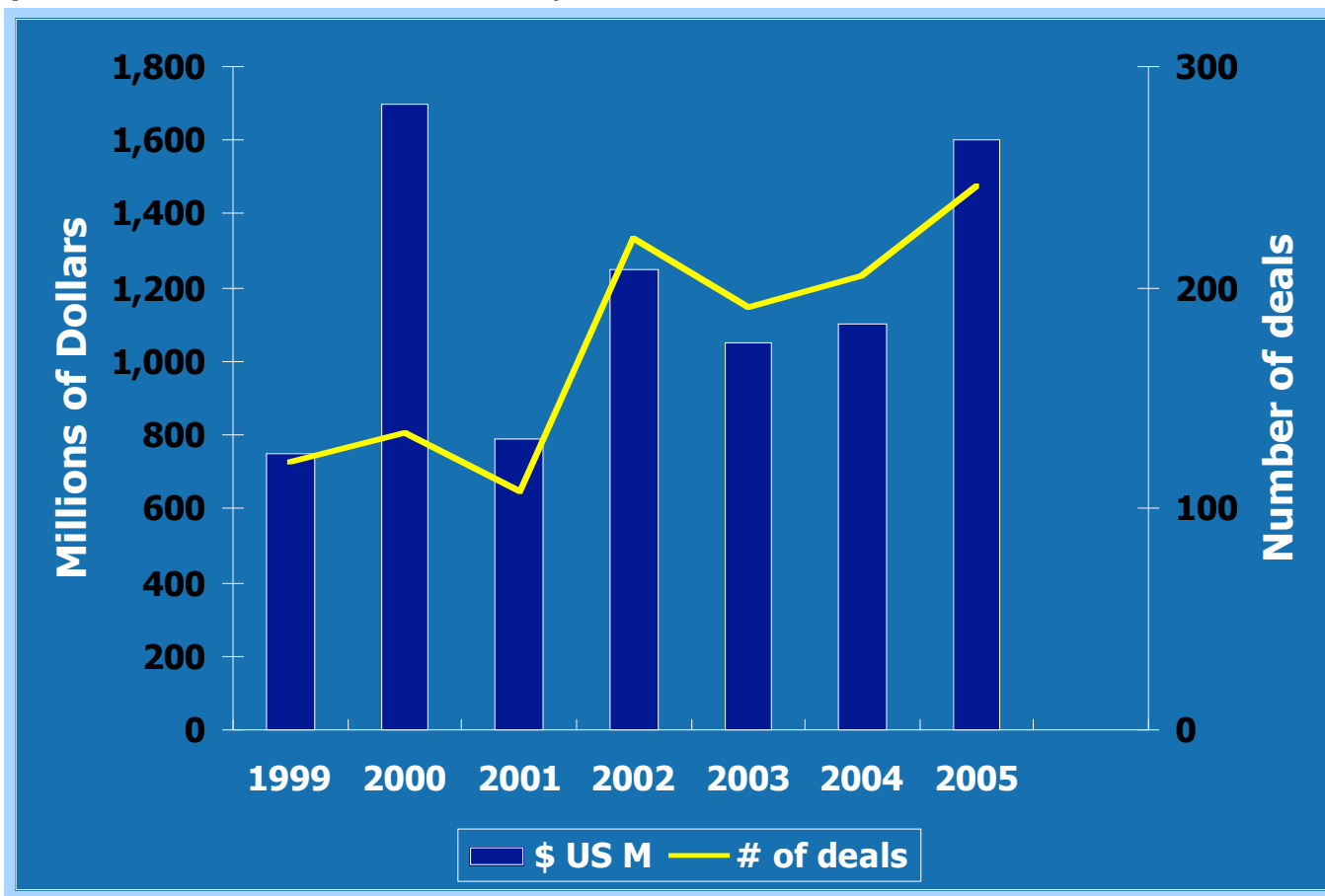
- Fundamental shift in demand curve for materials and energy forms
- Supply constraints due to resource limitations or infrastructure
- Strained shared resources (air, water, land)
- An increasingly electrified world due to Moore's and Metcalfe's Laws

- **Nanotechnology – ability to structure materials at the molecular level**
- **Materials design becoming CAD – ability to use high level design and synthesis tools for materials other than Si**
- **Chemistry, Biology and Process Technologies – ability to leverage biology and large scale processing technologies**
- **New and improved manufacturing technologies – for lower cost at economic scale or distributed manufacturing**
- **IT technologies spilling over to secondary markets through commoditization and volume**
  - Photonics and optical systems
  - Computational and simulation techniques
  - Semiconductor devices, processing and manufacturing technologies



## VC Interest in Energy is Growing

**North American Cleantech Venture Deals**  
(Europe is ~40%, Asia is ~10% of NA)

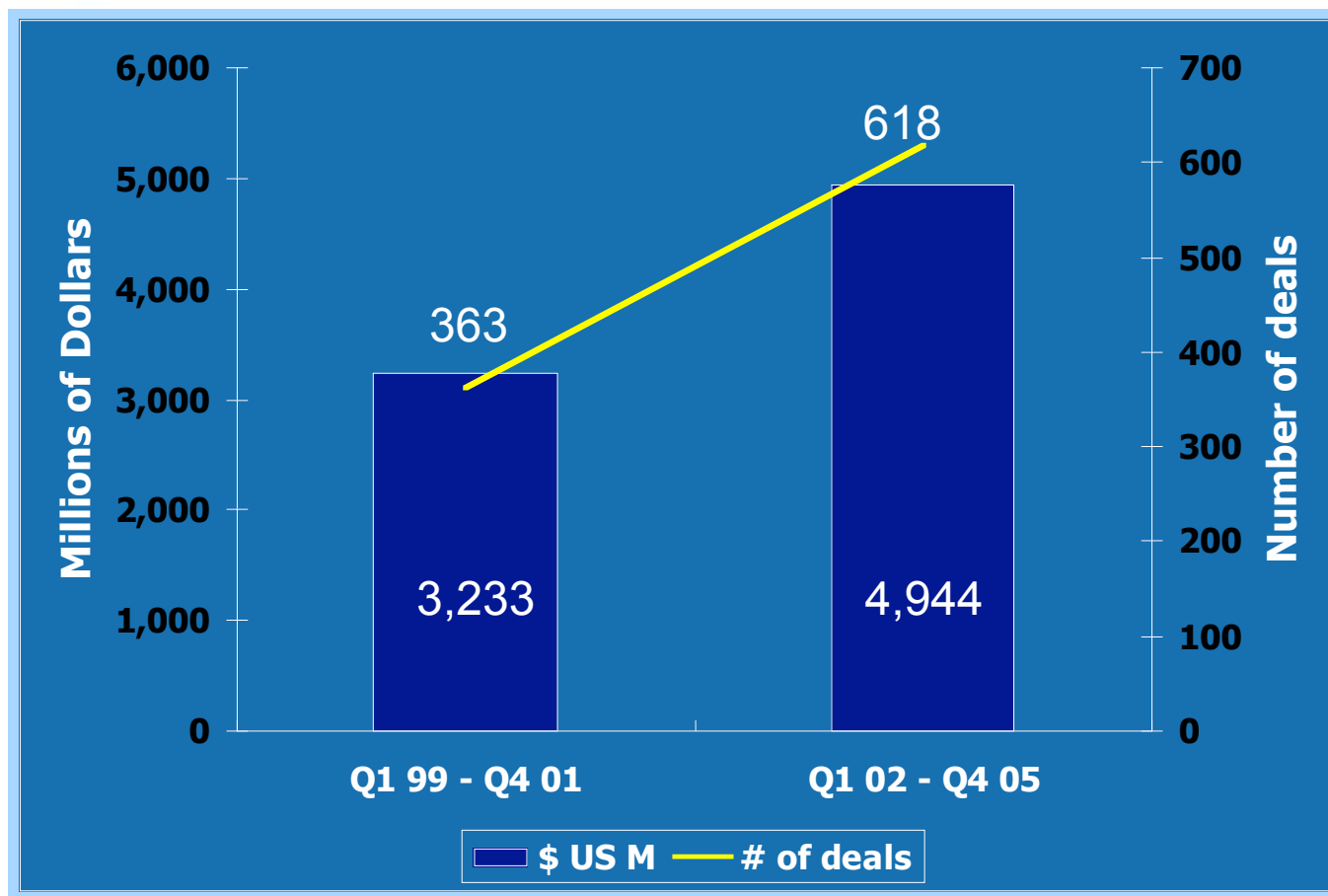


***Total Cleantech Venture Investing 1999-2005: \$8.2B***

Source: Cleantech Venture Network



## Two Phases of Investment



*Bubble & Burst*

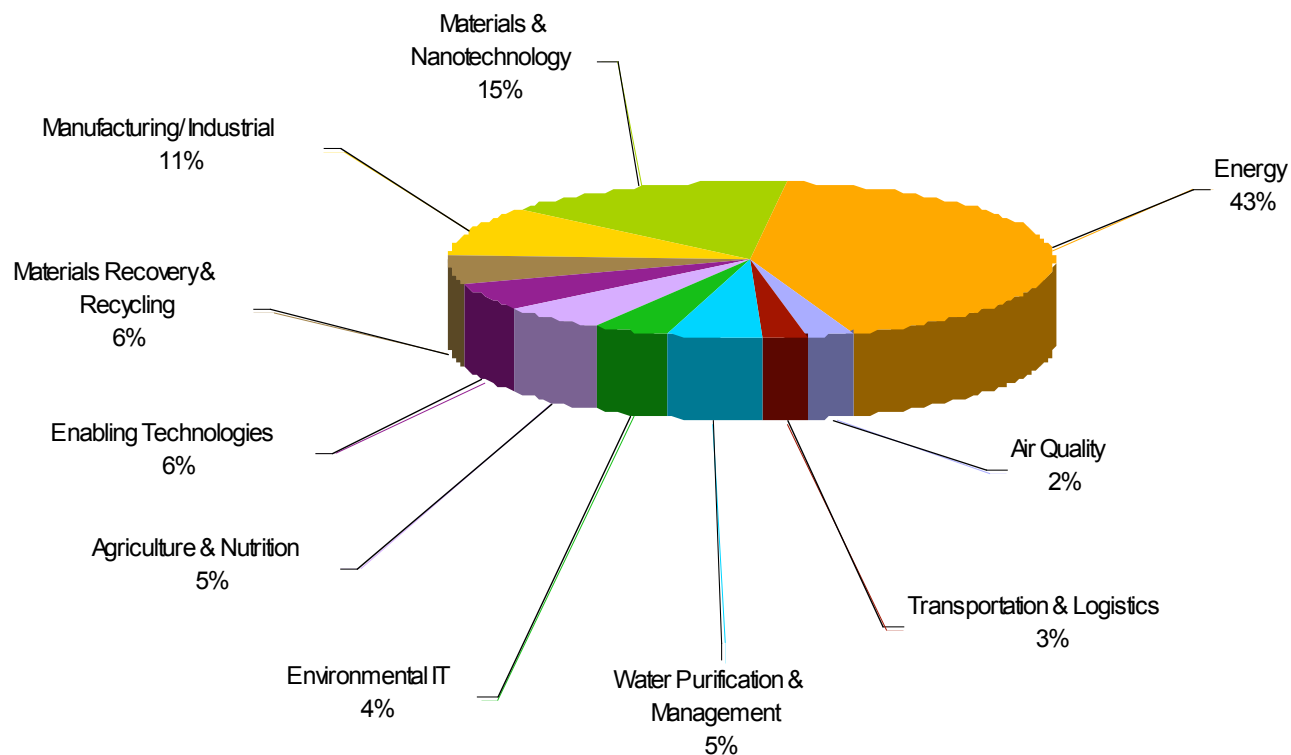
*Learning & Diversification*

***In Q405 Cleantech represented 9% of NA VC investment***

Source: Cleantech Venture Network

# Cleantech Investment by Segment

**Cleantech segments: by amount invested 1999 - 2005**



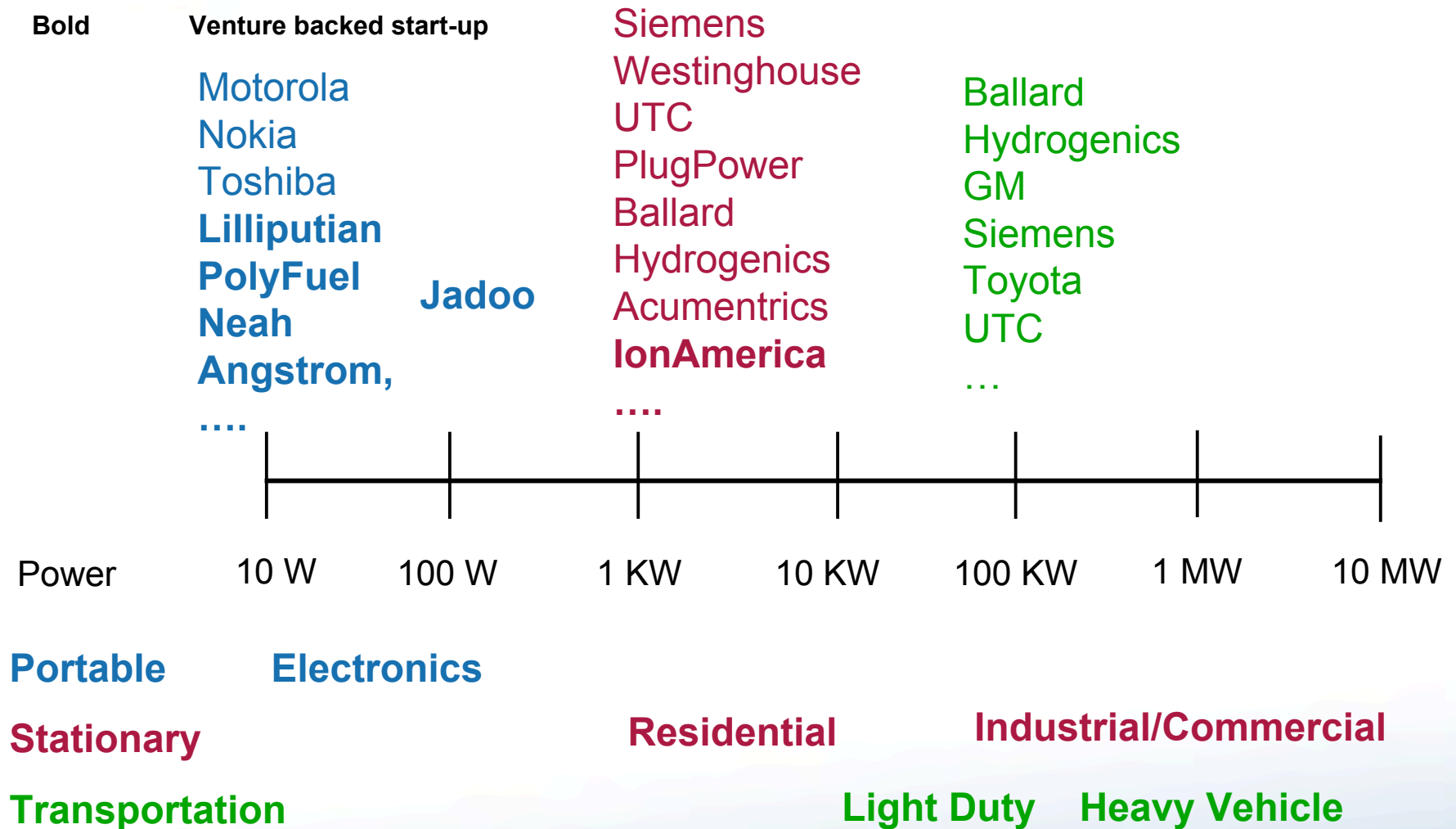
***Energy-related deals are leading: 43% of total cleantech by amount; 36% of number of cleantech deals.***

**Source: Cleantech Venture Network**

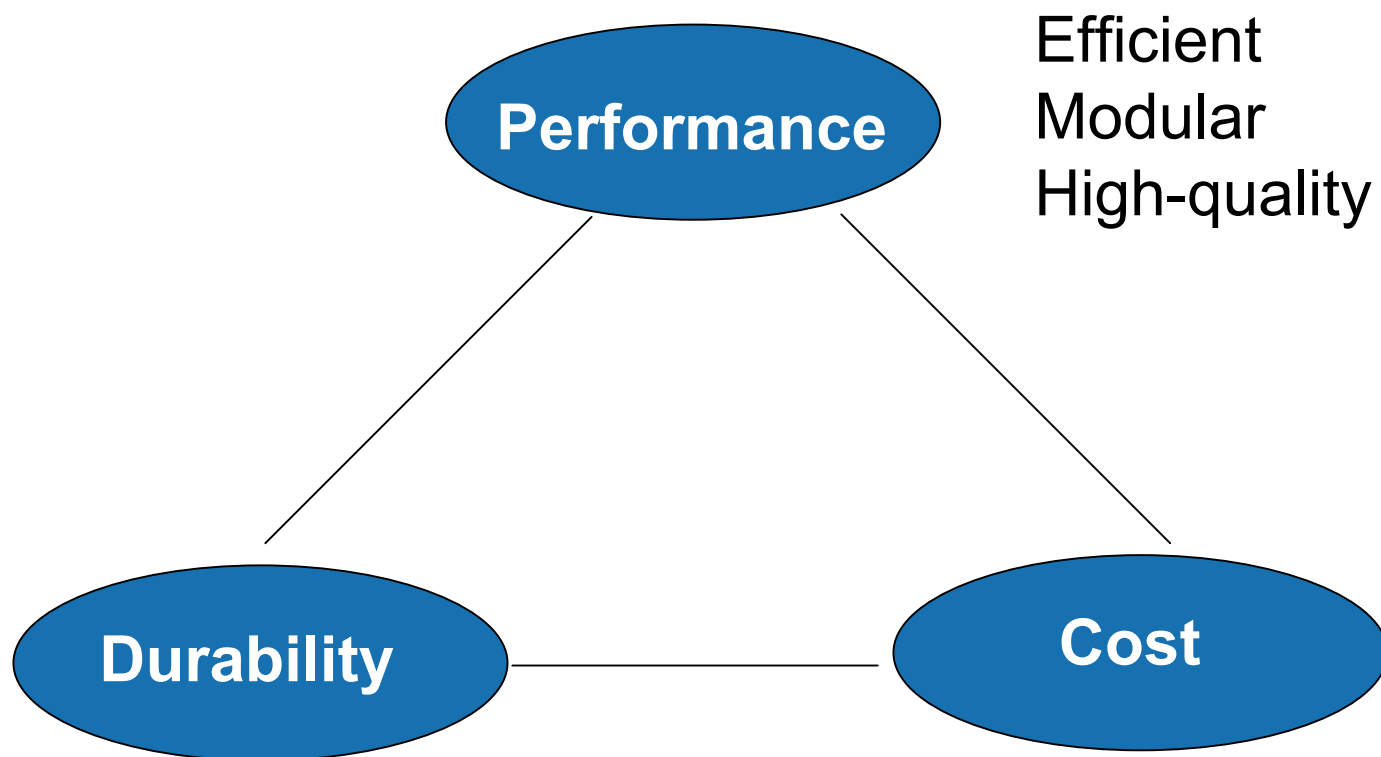
Application	Current Sources	Power (kW)	Markets	FC Types
Stationary / Distributed Generation	Grid (Coal, NG, Hydro)	1 – 10,000	Utility, Industrial, Commercial, Residential	SOFC MCFC PEMFC
Transportation (Drive)	IC Engine HEV	50 – 200	Automotive, Marine, Aerospace	PEMFC SOFC
Transportation (APU)	IC Engine	5 – 10	Trucks, Airplanes, Buses	SOFC PEMFC
Portable	Battery, Genset	0.1 – 5	Military, First responder, Bac	PEMFC SOFC
Micro	Battery	< 0.1	Cell phones, PDAs	DMFC PEMFC SOFC



# Many Companies developing Fuel Cell Technology



## Fuel Cell Technology – Still Early Stages



***Primary issue today is cost – focus on high value energy***

## Not all Watts are Equal

	Value
■ Wholesale power	\$0.04 / kWhr
■ Retail power (baseline)	\$0.08 / kWhr
■ Retail power (peak)	\$0.20 / kWhr
■ Portable power	
● Primary (Alkaline)	\$500 / kWhr
● Secondary (Lilon)	\$24.00 / kWhr
■ Transportation	
● Energy (gas@\$3/gallon)	\$0.09 / kWhr
● Efficiency of gas engine vs fuel cell	\$0.35 / kWhr

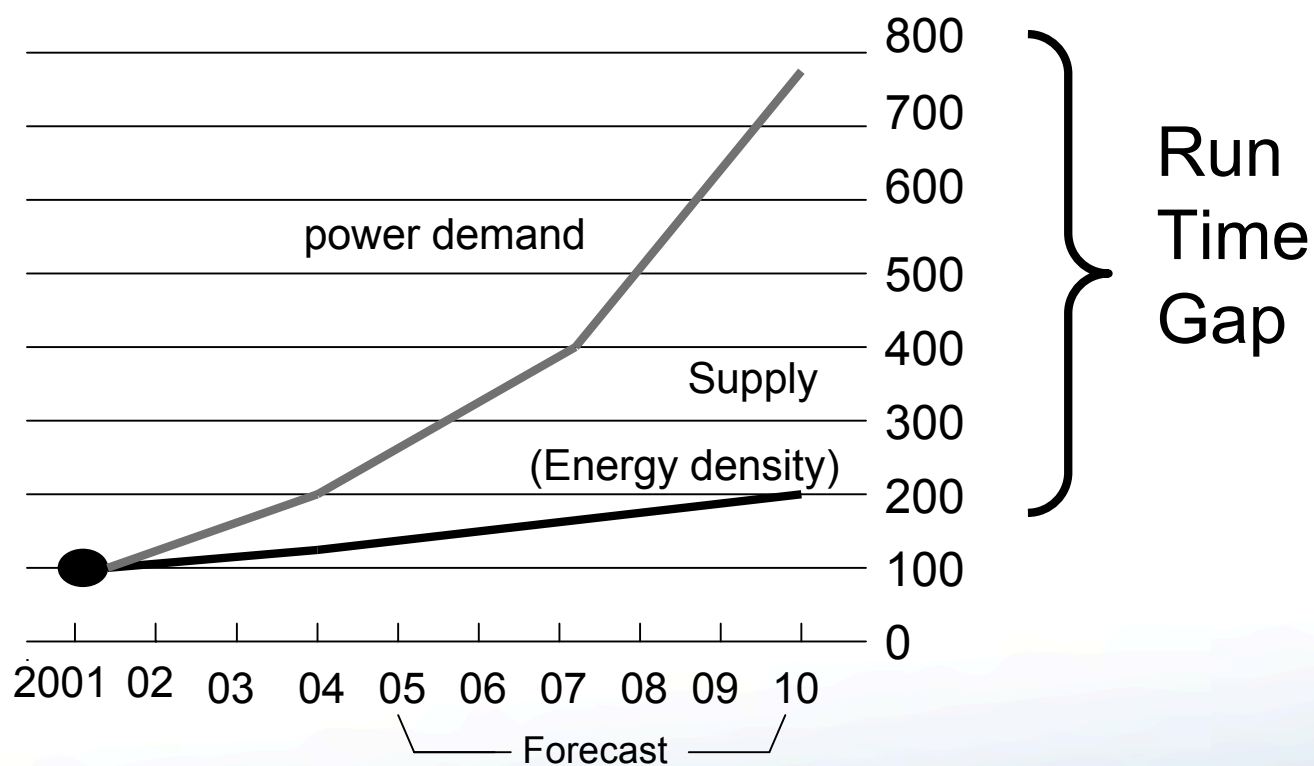


# Portable Applications – Market Opportunity

Flat batteries

**Mobile devices**

**2001=100**



Source: Boston Consulting Group

## ■ Applications:

- Micro - cell phones, PDAs, lap tops
- Portable - power tools, broadcast cameras, military, first responders

## ■ Challenges

- Incumbent technology: batteries, power cord to recharge
- Market landscape: consumer electronics vertically integrated
- Fuel infrastructure

## ■ Focus on mission-critical applications for strong value proposition

- Broadcast camera operators
- First responders
- Military

- **Fuel Cells are ideal distributed generators, enabling power to be sited at “point of use”**
  - Eliminate grid transmission losses
  - User security and control over own operations
  
- **Technology promises many benefits**
  - Very high conversion efficiencies
  - Low emissions – no combustion
  - High reliability – no moving parts
  - High quality power
  - Quiet operation



## ■ Challenges:

- Distributed Generation has very limited role today
  - 234 GW DG installed in the US, 30 GW grid interconnected
  - 81% is standby and back-up power generation
  - 86% of generators are internal combustion engines
- Diesel Gensets are cheap!

## ■ Need to create compelling economics

- > 16 cents / kWhr -> < ~10 cents / kWhr
- >\$4000 / kW installed -> < \$1000 / kW installed

- Environmental pressure to reduce emissions
- Homeland security pressure to reduce dependence on “foreign oil”



*20-25% conversion  
efficiency*

*Significant emissions*



*55% conversion  
efficiency*

*Emissions: Heat  
and water*

## ■ Challenges

- Very conservative industry – dominated by large players, slow to adopt
- Strongly entrenched incumbent technology
- Significant fuel infrastructure issues
- Other emerging contenders for “green” transportation are gaining momentum
  - Hybrid, Plug-in hybrid
  - Biofuels – E85, biodiesel
  - Both leverage existing infrastructure

## ■ Focus on likely early adopters: buses, fleets, forklifts

## ■ Have patience

- Need disruptive technologies, economics and proven performance to drive change



- **Fuel Cell technologies are promising across a number of markets**
- **But technology is still expensive and not generally proven**
- **Infrastructure issues for fueling are significant for portable and transportation applications**
- **Too much focus on “killer app” / mainstream app, must start with narrower focus**
- **Start-ups should focus on targeted applications with strong financial value proposition**

Thank you

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